

**REMARKS**

Claims 1-11 and 13-19 are pending in this application. By this Amendment, claim 12 is canceled, claim 19 is added and claim 17 is amended. Reconsideration based on the above amendments and following remarks is respectfully requested.

Applicants gratefully acknowledge that the Office Action indicates that claims 15 and 16 are allowed and claim 18 includes allowable subject matter.

Entry of the amendments is proper under 37 CFR §1.116 since the amendments: (a) place the application in condition for allowance (for the reasons discussed herein); (b) do not raise any new issue requiring further search and/or consideration (since the amendments amplify issues previously discussed throughout prosecution); (c) satisfy a requirement of form asserted in the previous Office Action; (d) do not present any additional claims without canceling a corresponding number of finally rejected claims; and (e) place the application in better form for appeal, should an appeal be necessary. The amendments are necessary and were not earlier presented because they are made in response to arguments raised in the final rejection. Entry of the amendments is thus respectfully requested.

**I. Restriction Requirement**

The Office Action asserts that claims 1-12 are drawn to an non-elected invention with traverse. Thus, the Office Action asserts that claims 1-12 must be canceled in response to the final rejection. However, this assertion is respectfully traversed. As indicated in the October 9, 2002 Restriction Requirement, MPEP §806.05(e) states that a process and apparatus for its practice can be shown to be distinct if either or both of the following are present: (1) the process as claimed can be practiced by another materially different apparatus or by hand, or (2) the apparatus as claimed can be used to practice another and materially different process.

However, MPEP §806.05(e) also states that, for example:

If the apparatus claims include a claim to "means" for practicing the process, the claim is a linking claim and must be examined with the elected invention. If it is ultimately allowed, rejoined or as required.

Since MPEP §806.05(e) provides an example of a linking claim, new claim 19 is a method claim to steps practiced by the apparatus of the elected claims. Therefore, claim 19 is a linking claim that links the method and apparatus claims, and must be examined with the elected invention. When linking claim 19 is ultimately allowed, then rejoined or of method claims 1-11 is required.

Further, a thorough search of the subject matter of claim 19 would encompass a search for the remaining method claims. Applicants thus respectfully submit that the grounds for restriction, even if previously proper are no longer proper in view of new claim 19.

## **II. The Claims Define Allowable Subject Matter**

The Office Action rejects claims 13 and 14 under 35 U.S.C. §102(b) as unpatentable over Japanese Patent Publication No. 61-284573A ("JP'573"); and claim 17 under 35 U.S.C. §103(a) is patentable over Japanese Patent Publication No. 11-316220A ("JP'220") in view of U.S. Patent No. 4,845,041 to Scuitto et al. ("Scuitto"). These rejections are respectfully traversed.

### **a) Claim Rejection - 35 U.S.C. §102**

JP'573 does not disclose a cathode for holding a sample, anodes arranged to counter the cathode, a pretreatment chamber storing the cathode, or a metal sample under an inert gas atmosphere, as recited in claim 13.

Instead, JP'573 discloses depositing a target material 3 on an object to be processed (not illustrated) by ionization and evaporation using magnetron. See attached translation page 2, line 7 - page 3, line 2; and page 4, lines 3-24. Further, JP'573 discloses that target 3 is a material to be evaporated by plasmas 7 and then deposited on the object. Additionally, JP'573

discloses that target 3 includes grooves 4. Since target 3 is not a sample, grooves 4 of target 3 is not a sample as asserted by the Office Action. Further, contrary to the subject matter recited in claim 13, the target 3 of JP'573 is never transferred to an analysis section.

JP'573 discloses that the target 3 is made of ferromagnetic material and functions as a cathode disposed on the upper surface of the magnet 2. See translation page 4, lines 5-7. In contrast, the cathode recited in claim 13 holds a separate metal sample. JP'573 does not disclosed that the target 3, which acts as a cathode, holds a sample. JP'573 is completely devoid of this feature.

Even if the groove 4 of target 3 can be considered a sample and the magnet support bed 1 can be considered a cathode as asserted by the Office Action, the magnet support bed 1 directly supports the magnets 2, not the target 3.

The Office Action asserts that a chamber is inherent so that the anodes 5, the magnet support bed 1 and the grooves 4 can be located under an inert gas atmosphere. Although JP'573 discloses a high vacuum or super-high vacuum region, the fact that treatment is conducted only at a reduced pressure does not inherently suggest that treatment is performed in an inert gas atmosphere. Thus, JP'573 is completely devoid of this feature.

Concerning the term "counter" recited in claim 13, the Office Action has interpreted this terminology in terms of opposing polarity of the cathodes and anodes and not to a particular positional relationship of the cathodes and anodes.

However, "arranged to counter" is recited in claim 13 and this stands to reason that "arrangement" of electrodes is specified in the claim. In other words, "arranged to counter" as recited in claim 13 means that, as is conspicuous from the drawings of this application, the cathode and anodes are arranged in a generally face-to-face formation. The wordings, "arrange to" will not be necessary in expressing merely "opposing charges" or "alternative

charges". This is because "opposing charges" is evident for one of ordinary skill in the art when the wordings of "cathode" and "anode" are used independently.

The arrangement of cathodes and anodes depicted in the drawings of JP'573 is clearly not an "opposing" arrangement as recited in claim 13. In contrast, the cathodes, according to JP'573, are arranged plurally and concentrically in a ring-shaped groove, whereas anodes are disposed in the ring-shaped groove part.

b) **Claim Rejection - 35 U.S.C. §103**

JP'220 does not disclose an analyzing apparatus including means for cooling at least one target site, at least one of the target sites including at least one of electrodes for sputtering, counter electrodes for sputtering, and a holder, as recited in claim 17.

The Office Action admits that JP'220 does not disclose a means for cooling. The Office Action asserts that this deficiency is made up by Scuitto. Specifically, the Office Action asserts that Scuitto discloses a cooling means. Thus, the Office Action asserts that it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to combine the teachings of JP'220 with the cooling means taught by Scuitto to draw off the heat from the electrode during sputtering. However, Scuitto does not make up for the deficiencies of JP'220. Nor does Scuitto disclose the features asserted to it by the Office Action.

Instead, Scuitto discloses a means to cool only the cathode, which is next to the sample, to draw away heat from and thus, cool the periphery of the sample surface. In contrast, claim 13 recites means for cooling at least one target site, which could include the electrodes for sputtering, the counter-electrodes for sputtering, and/or the holder, as recited in claim 17. Scuitto is completely devoid of this feature.

For at least these reasons, it is respectfully submitted that claims 13 and 17 are distinguishable over the applied art. Claims 14 and 18, which depend from claim 13, are

likewise distinguishable over the applied art for at least the reasons discussed, as well as for the additional features they recite. Withdraw of the rejections under 35 U.S.C. §§102(b) and 103(a) is respectfully requested.

**III. Conclusion**

In view of the foregoing amendments and remarks, it is respectfully submitted that this application is in condition for allowance. Favorable reconsideration and prompt allowance of claims 1-11, 13-14 and 17-18 are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number set forth below.

Respectfully submitted,



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Attachment:  
English Translation of JP'573

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## Specification

### 1. Title of the Invention

Discharge electrode

### 2. Scope of the Claim for Patent

A discharge electrode in which plural electrode members each separated with a ring-shaped groove are provided concentrically to the inside of radially generating closed magnetic fields, the electrodes are caused to function as a cathode and an anode is provided to the ring-shaped groove part of the electrode members.

### 3. Detailed Description of the Invention

#### [Technical Field of the Invention]

The present invention concerns a discharge electrode and, more in particular, it relates to a discharge electrode applied, for example, to a discharge cathode of a sputtering apparatus.

#### [Technical Background of the Invention and Problems Therein]

Heretofore, various discharge cathodes were applied in sputtering and, usually, a so-called magnetron system in which a flat plate target is disposed on the upper surface of a magnet disposed concentrically was used for instance. In the discharge electrode described above, a high voltage is applied between the electrode and an object to be processed and plasma discharge is generated to a portion perpendicular to the electric field

generated thereby, to scatter the target member and deposit the same to an object to be processed.

However, in a case where the target member is formed of a ferromagnetic material in the electrode, magnetic fluxes generated by the magnet penetrate the inside of the target making plasma discharge difficult.

[Object of the Invention]

The present invention has been achieved in view of the foregoing and intends to provide a discharge electrode capable of reliably generating plasma discharge even in a case of using an electrode member made of a ferromagnetic material and keeping stable discharge at a voltage lower than the existent discharge voltage.

[Summary of the Invention]

For attaining the foregoing object, in the discharge electrode according to the present invention, plural electrode members each separated with a ring-shaped groove are provided concentrically to the inside of radially generating closed magnetic fields, the electrodes are caused to function as a cathode and an anode is provided to the ring-shaped groove part of the electrode members whereby stable plasma discharge is obtained at a low voltage by simultaneously generating magnetron discharge, hollow cathode discharge and Penning discharge in the grooves.

[Example of the Invention]



Examples of the present invention are to be described with reference to Fig. 1 to Fig. 3.

Fig. 1 shows an example of the invention in which a magnet 2 is secured in a concentric manner on a magnet support base 1 made of iron, and a target 3 made of a ferromagnetic material as a cathode is disposed on the upper surface of the magnet 2. The target 3 is divided concentrically by forming circular grooves 4 at a position corresponding to the gaps of the magnet 2, and the periphery of the target 3 is tapered being diverged upwardly in this example. Further, a water-cooled anode 5 is located below the portion of the groove of the target 3, and a gap between the anode 5 and the target 3 is formed narrow, for example, to 1 - 2 mm such that plasmas do not intrude therethrough. Further, another anode 6 is disposed above the anode 5 but this anode may optionally be saved.

In this example, when a high voltage is applied between the anode 5 and the target 3, magnetic fields generated as shown by arrows exert between the anode and the tapered surface of the target 3 thereby simultaneously generating magnetron discharge, and discharges based on the Penning's principle and discharge based on the hollow cathode principle to generate discharge plasmas 7. The plasmas 7 ionize to evaporate the material on the tapered surface of the target 3 and deposit the same on an object to be processed (not illustrated).

Accordingly, in this example, since the plasmas 7 are

generated by exertion of magnetic fields using the target 3 as a magnet, even a target made of a ferromagnetic material can reliably generate plasmas stably to reliably scatter the target material. Further, in this example, sputtering can be conducted even at high vacuum or super-high vacuum region of  $10^{-4}$  to  $10^{-5}$  or less, whereas sputtering is possible in the existent plasma generation means only in a vacuum region at about  $10^{-3}$  Torr.

Further, as shown in Fig. 2, a similar effect can also be obtained by locating the anode 5 in the portion of the groove 4 of the target 3 and, further, the magnet 2 may be an electromagnet, or taper may not always be formed to the circumferential surface of the target 3.

Further, Fig. 3 shows another example of the invention in which a target 3 is formed into a thin configuration, and an anode 6 is disposed to the outer circumference of the target 3. In this example, since plasmas 7 are generated by the application of a high voltage not only to the portion of the groove 4 of the target 3 but also to the upper surface portion of the target, the target material 3 can be scattered over a wide range thereby enabling to conduct uniform processing for the object to be processed.

The present invention is applicable not only to the sputtering using a flat plate type target but also to a sputtering apparatus in which a target as a discharge electrode is formed

cylindrically and, further, it is applicable also to an ion source in ion etching in addition to sputtering.

[Effect of the Invention]

As has been described above, in the discharge electrode according to the present invention, since the anode is disposed to the groove gap between the electrode members that functions as a cathode, and the anode is positioned at a portion surrounded with the cathode to which the magnetic force exerts, plasmas can be generated reliably even in a case where the electrode member is made of a ferroelectric material by the Penning's principle. Further, according to the principle described above, it can provide an advantageous effect, for example, capable of generating plasmas in a high vacuum or super-high vacuum region.

#### 4. Brief Description of the Drawings

Fig. 1 to Fig. 3, respectively, show examples of the present invention in which, Fig. 1 and Fig. 3 are vertical cross sectional views and Fig. 2 is a vertical cross sectional view for a portion.

- 1 --- magnet support bed
- 2 --- magnet
- 3 --- target
- 4 --- groove
- 5, 6 --- anode

7 --- plasma